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Towards Incorporating More Realistic Effects in Variational Monte Carlo studies of the Fractional Quantum Hall Effect in Graphene[1]
YONAS GETACHEW, MICHAEL PETERSON, California State University Long Beach — A two-dimensional electron system exposed to a strong perpendicular magnetic field (10 to 30 T) and cooled to very low temperatures (less than 1K) forms a new state of matter that exhibits the fractional quantum Hall effect (FQHE). This phenomenon has been observed in graphene, a naturally occurring two-dimensional electron system. Electrons in graphene have spin and valley degrees of freedom and the physics (e.g., spin and valley polarizations) has remained mysterious. Any accurate model of the FQHE in graphene needs to account for Landau level mixing, a model for which has been formulated in terms of Haldane pseudopotentials using the planar geometry and includes the emergence of three-body interactions between the electrons, in addition to renormalizing the two-body interactions. We discuss a real space formalism that can be used in variational Monte Carlo studies. The method involves an ansatz potential with adjustable parameters such that its pseudopotentials match those found through other methods. We discuss extensions of this formalism to the finite-sized spherical geometry as well as developing a formalism to handle the three-body interactions.

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